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14. ABSTRACT

This project is part of a "portfolio" comprising four other projects to investigate the possibility of operating a collection of intelligent autonomous agents so that the collection can understake complex missions. To determine this, we are testing a new routing algorithm in which nodes are known by their geographical address. In additional, we have developed a MAC layer protocol for forming a "ring" network among nearby agents. Finally we are formulating a mathematical problem that captures the essence of data provisioning based on the work of John Chuang and recent developments in teh Internet known as "layer 5" switching and "content ditribution networks."

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Data Provisioning Systems for Autonomous Vehicles

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Progress Report for Period 5/99 – 9/99

Summary

This is the progress report of the project, *Data Provisioning Systems*, for the 5-month period May 1999 - September 1999.

Research advanced in several domains: (1) architecture of data provisioning systems; (2) geographical routing for *ad hoc* networks; and (3) medium access control protocols for "ring networks" with hidden terminals.

The tangible products of the research are:

- A preliminary architecture of the communication networks that can support the data/information needs for systems of autonomous vehicles engaged in complex missions;
- A preliminary algorithm for geographical-based routing of packets through a wireless *ad hoc* network that appears to be superior to existing routing algorithms along several performance metrics;
- A preliminary medium access control (MAC) protocol for wireless ring networks that is compatible with IEEE 802.11 standards.

Objective

It seems possible to operate a collection of intelligent autonomous agents so that the collection can undertake complex missions. The intelligence of the system resides to a significant extent in the organization. The organization can accomplish missions that individual agents cannot. The organization coordinates the decisions taken by the various agents. To carry out this coordination requires an "infrastructure" that meets the agents' needs for data and for communication. We call this infrastructure a Data Provisioning System (DPS). The objective of this project is to conduct research in the design of DPS.

This project is part of a "portfolio" comprising four other projects. Andrea Goldsmith's project is concerned with characterizing the channels (physical layer) that are likely to be encountered in these missions. Martha Steenrup's project deals with routing. P.R. Kumar's research seeks to evaluate the total capacity of these networks.

Results to date

Geographical Routing. We are testing a new routing algorithm in which nodes are known by their geographical address. The algorithm requires routing table of the size of log n, if there are n nodes. This is significantly smaller than the algorithms published in the literature. We are developing a set of performance metrics for comparing alternative algorithms.

MAC layer protocols. We have developed a MAC layer protocol for forming a "ring" network among nearby agents. The advantage of a "ring" is the guaranteed performance (in terms of latency and bandwidth). The protocol permits new agents to be added to the ring, and others to be removed. We are formally specifying the algorithm so that correctness can be proved.

Data Provisioning. Based on the work of John Chuang and recent developments in the Internet known as "layer 5" switching and "content distribution networks" we are formulating a mathematical problem that captures the essence of data

provisioning in our context. The mathematical problem displays the tradeoff between bandwidth availability and early provisioning.